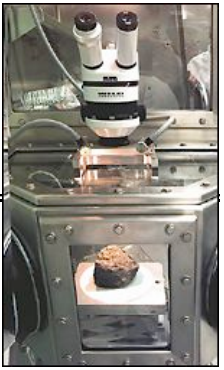
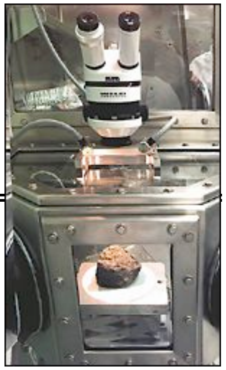


Report on the ESA-CNES MSR Conference, July 9-10, 2008

David Beaty and Lisa May

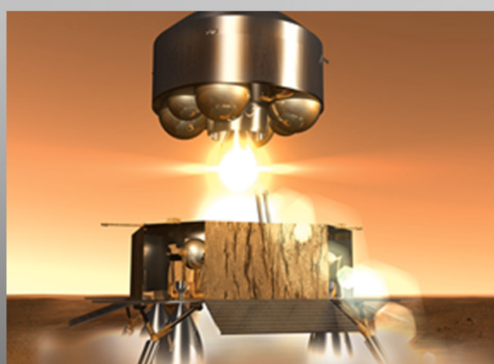
Sept. 18, 2008



What did iMARS present?

Mission rationale, Science objectives, Samples needed to achieve objectives

David Beaty



Why Return Samples?

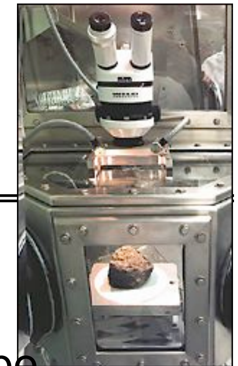
There are three primary reasons why MSR would be of such high value to science.

1. Complex sample preparation, sample decisions

Image courtesy Dimitri Papanastassiou

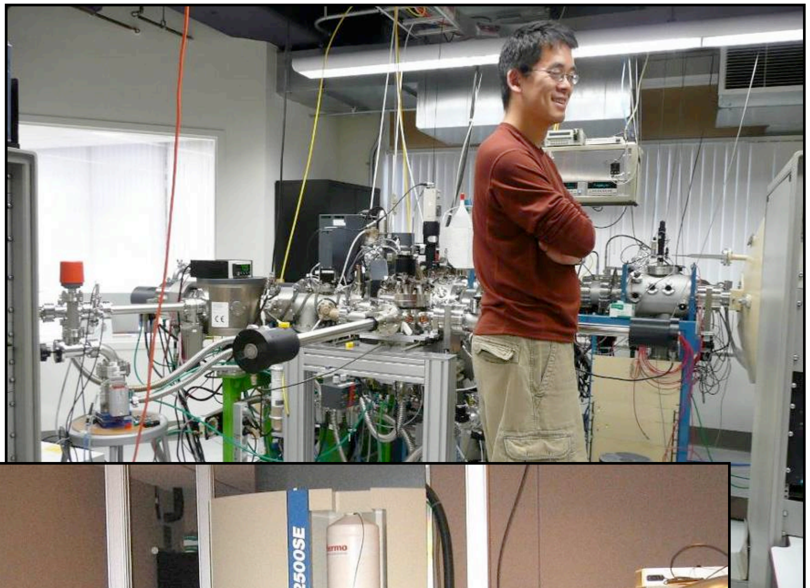
Image courtesy Carl Allen

Why Return Samples?

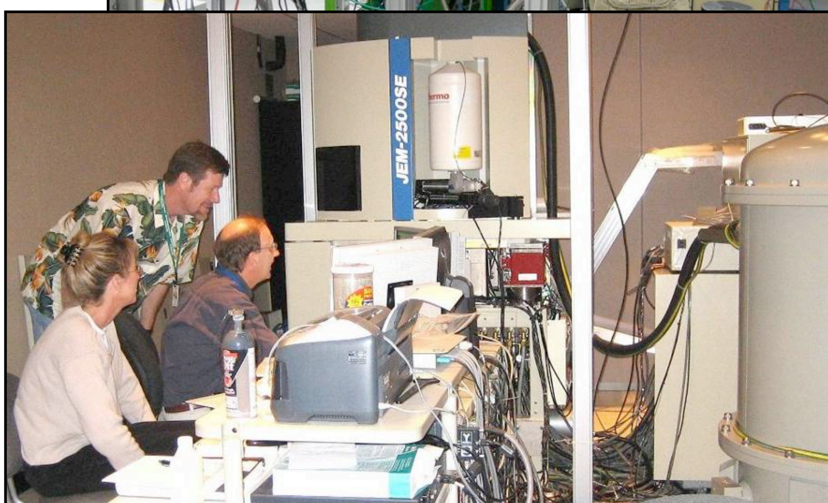


2. Analysis Adaptability

- Not limited by prior hypotheses



UCLA MegaSIMS lab, courtesy Kevin McKeegan



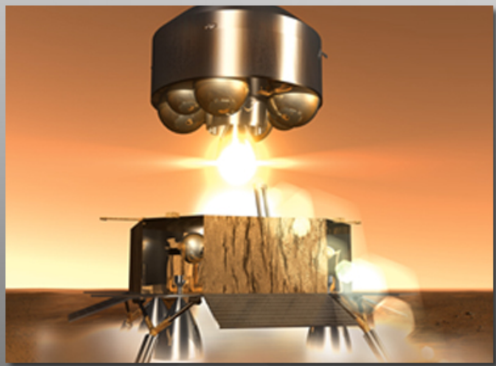
JSC TEM lab, courtesy Lisa Fletcher

3. Instrumentation

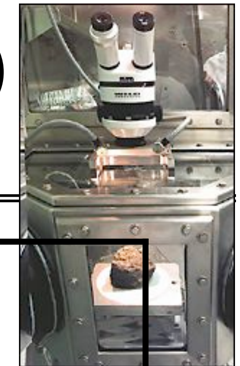
- Best accuracy/precision
- Diversity—results could be confirmed by alternate methods
- Instruments not limited by mass, power, V, T, reliability, etc.
- Calibration, positive and negative control standards
- Future instrument developments

Draft High-Level Requirements, Architecture, Development Timeline

Denis Moura

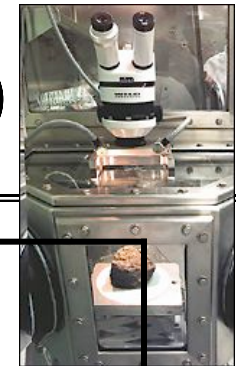


Draft High-Level Requirements (1)



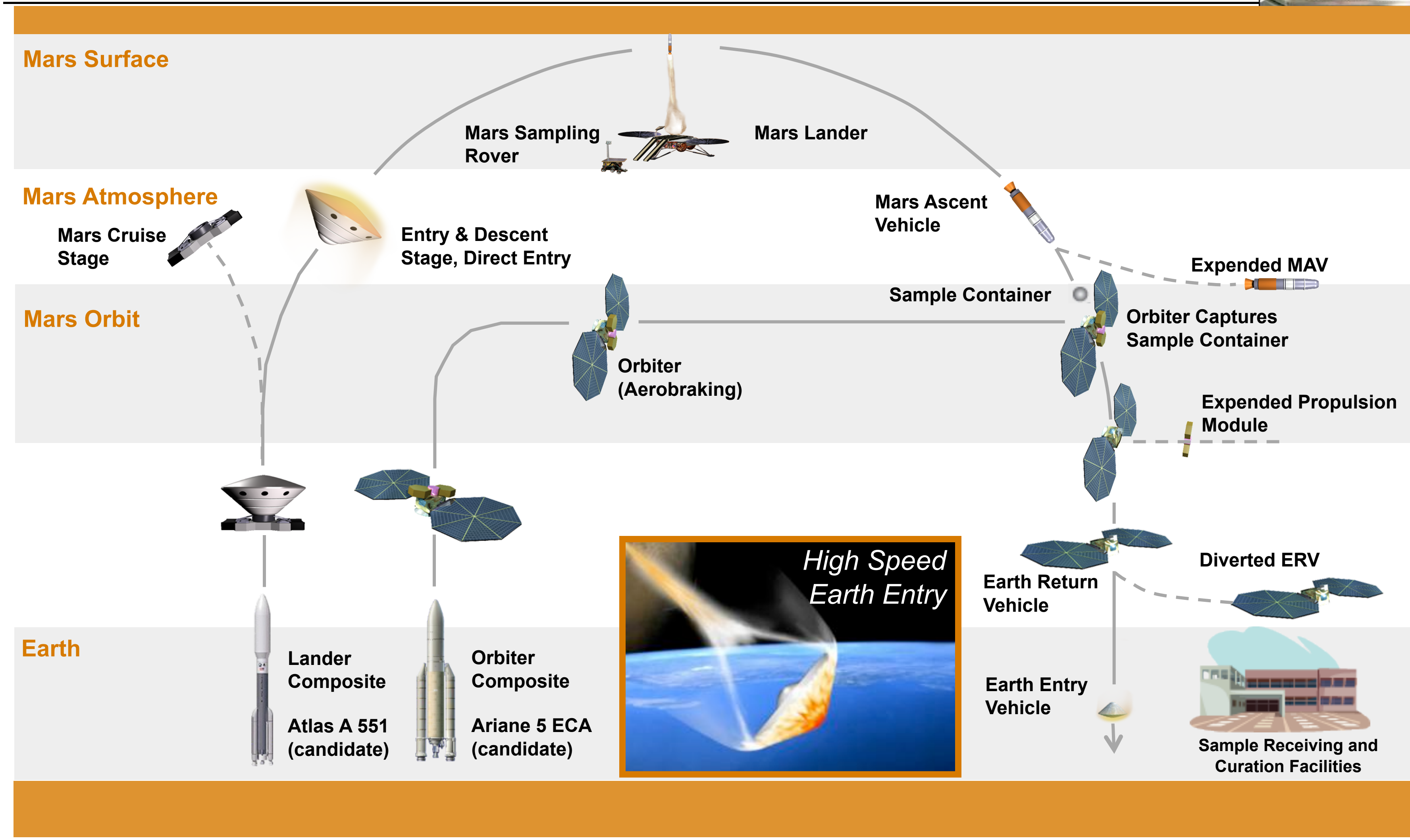
Category	Draft Requirement
Sample types to meet science objectives	MSR would have the capability to collect samples of rock, granular materials (regolith, dust) and atmospheric gas
Sample mass	MSR would return a minimum of 500 g of sample mass
Sampling redundancy including contingency samples at landing site	MSR would have both a rover-based sampling system and a lander-based sampling system
Sample encapsulation	MSR would have the capability to encapsulate each sample in an airtight container to retain volatile components of solid samples with the associated solid samples and protect samples from commingling
Cache retrieval	If Mars Science Laboratory (MSL) ends its mission in an accessible location with a cached sample on board, MSR should be designed to have the capability to recover the cache(s)

Draft High-Level Requirements (2)



Category	Requirement
Horizontal mobility to acquire diverse samples needed to meet science objectives	In order to sample various geological sites, MSR would have the ability to rove to the edge of its landing error ellipse (“go-to” capability), carry out a 2.5 km sample acquisition traverse, then return to the lander
Landing site latitude range	MSR would be able to access landing sites within +/- 30 deg latitude
Planetary protection	All MSR flight and ground elements would meet the planetary protection requirements established by COSPAR; an MSR mission is classified as category V, restricted Earth return
International cooperation	MSR mission planning would enable international cooperation
Timing	The launch of Lander Composite would be no later than 2020

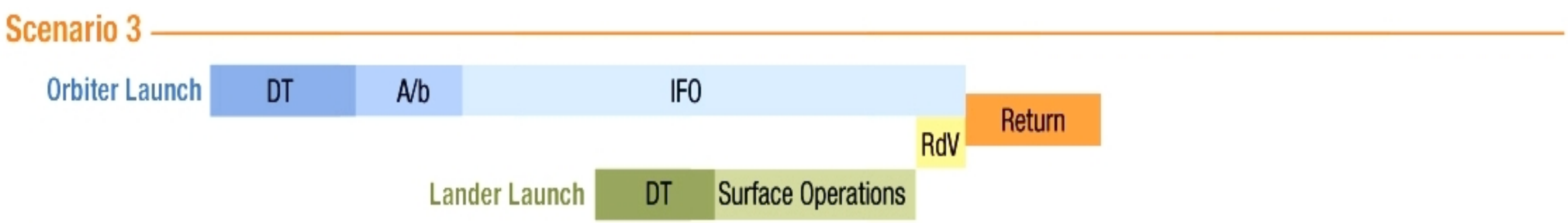
Proposed MSR Architecture



Analysis of MSR Mission Options
(Lander TC from MSR orbiter)

2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025

Lander composite option to be launched in 2020



Lander option to be launched in 2022

Abbreviations:

A/b: aerobraking; **DT**: Direct Transfer (no Earth swing-by); **RdV**: Rendezvous and Capture; **IFO**: In-flight operations.

Analysis of MSR Mission Options (Lander TC from another mission)

2017	2018	2019	2020	2021	2022	2023	2024	2025

Lander composite option to be launched in 2018, before the Orbiter composite option

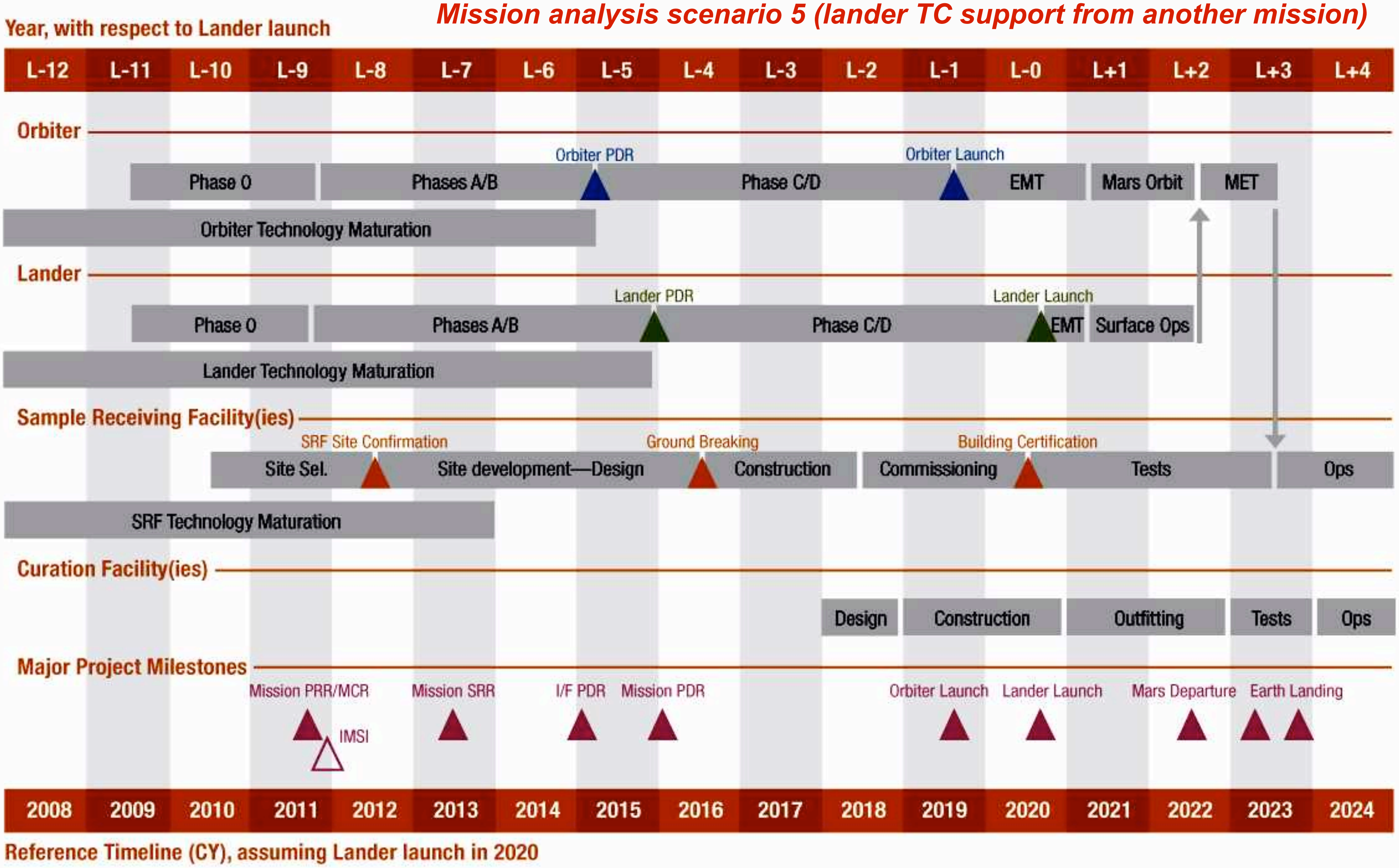
Lander option to be launched in 2020, before the Orbiter composite option

Lander option to be launched in 2020, after the Orbiter composite option

The one considered later on

MSR Potential Timeline

Mission analysis scenario 5 (lander TC support from another mission)

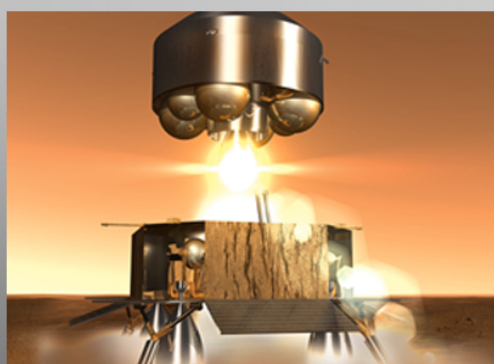


Associated Technology Maturation Plan

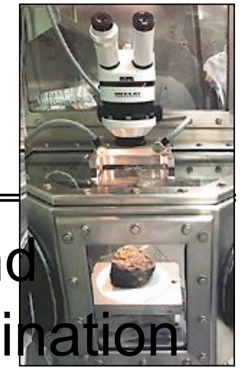
	CY 2008	CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014	CY 2015	CY 2016
	Ld -12	Ld -11	Ld -10	Ld -9	Ld -8	Ld -7	Ld -6	Ld -5	Ld -4
Orbiter Technology									
Orbiter								Orbiter PDR	
Rendezvous and Sample Capture			Concept Selection			Simulation		Test and Validation	
Back Planetary Protection			TRL 4					TRL 6	
Earth Entry Vehicle			Thermal Protection System Tests			TRL 6	Sub-assembly EDU		Flight Test
Lander Technology									
Lander								Lander PDR	
Forward Planetary Protection		Perform Trades			TRL 4			TRL 6	
Sample Acquisition, Transfer, & Encapsulation						Corer Technology TRL 6		Rover Based Coring Demonstration	
Faster Mobility System				Algorithms Developed		FPGA Implementation			
Precision Landing				Simulation			EDL Design		
Hazard Avoidance			Concept Selection		Preliminary Design		Tests in Real-Time Testbed	Field Test	
Mars Ascent Vehicle					Technology at TRL 6			MAV Critical Design Review	
SRF Technology									
SRF									SRF Construction Start
SRF Technology				Double-walled Containment	Robotics	Test/Integration			

Protecting the Earth, Mars and the Samples

Gerhard Kminek



Planetary Protection Summary



- Protecting the Earth from potential martian hazards and protecting the martian samples from terrestrial contamination throughout all mission phases would introduce considerable complexity in the mission design for MSR

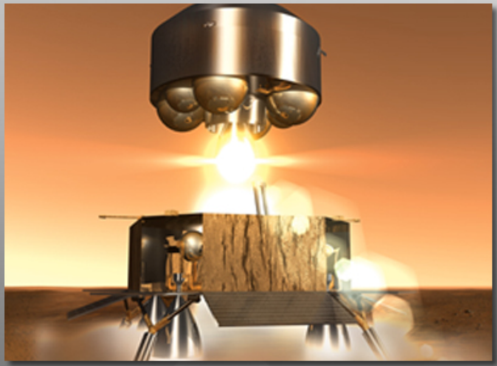
- The sample receiving facility(ies) is a long-lead item that would need to be addressed in the pre-project phase
  - *full development, approval and commissioning covers one decade*

- Ground facilities (i.e., containment and curation) would of necessity be long-term investments, beyond the return of the samples

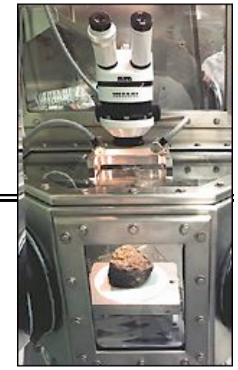
- Communication with the public of particular importance with respect to the sample containment facility(ies)

Science Management Plan

Monica Grady

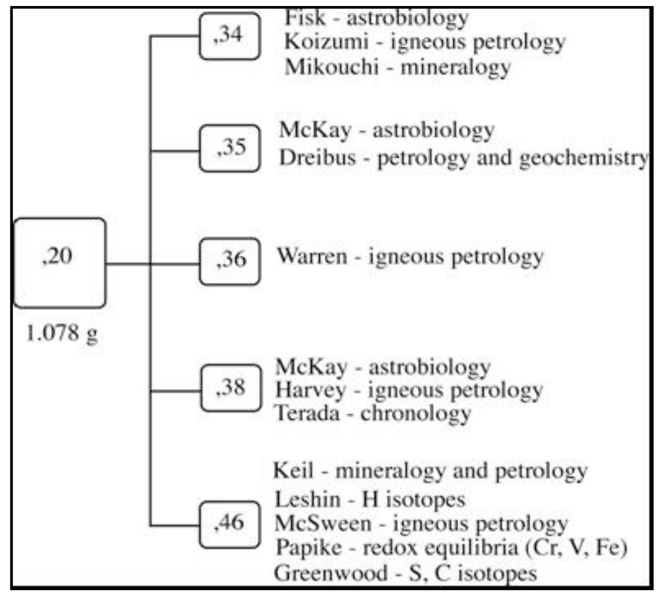


Internationalizing MSR Science

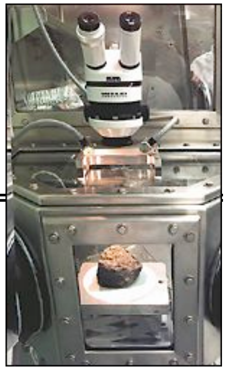


- A significant challenge for an international MSR would be the process by which a large, diverse, international science team would be managed
- How would international participation in the following critical science-related decisions be managed?
  - where to land,
  - which samples to collect,
  - Mars surface operations strategy, and its relationship to risk management
  - subdivision of the samples once back on Earth
  - allocation of the samples to PIs

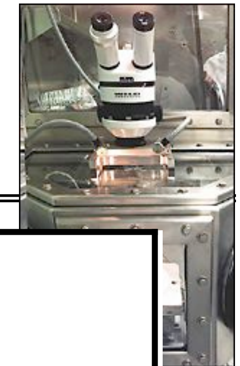
EXAMPLE: Sub-division and allocations for part of Mars meteorite QUE-94201



- Would require an international 'oversight body' that includes
  - international and technical diversity
  - budget decision-makers
  - scientists, engineers, strategic planners, and managers
- Proposal for International MSR Science Institute (IMSI)

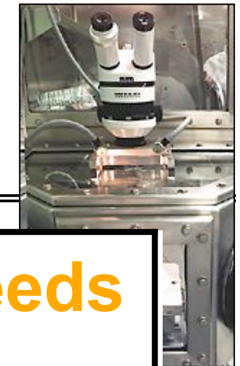


What was the reaction?



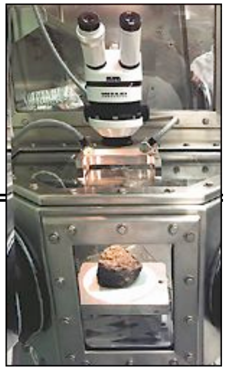
Reaction

MEPAG ND-SAG findings, including science objectives, sample size/mass/diversity, sample preservation	REASONABLE
Draft requirements	REASONABLE
Flight architecture	REASONABLE
Technology maturation plan	REASONABLE
Timeline	MSR lander in 2020 too fast? 2022?



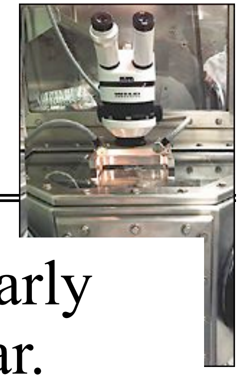
Reaction

IMSI	Interesting concept, needs more refinement
Building an international coalition	Valuable goal, will take some work



What has happened since July, 2008?

What's Next?



- IMEWG is considering a charter for iMARS Phase II; early indications are favorable. Would start after the new year. This would continue to provide a vehicle for coordinating international MSR planning.
- ESA is preparing their submission for the Ministerial Conference in November (2008) and they currently planning to propose a 3-year MSR Preparatory Programme.
- In the NASA budgeting process, consideration is being given to increasing funding for MSR Advanced Technology. Timing and amount is TBD. Next budget release ~Feb. 2009.
- Other space agencies are evaluating their priorities and financial/technical options for participation in MSR.